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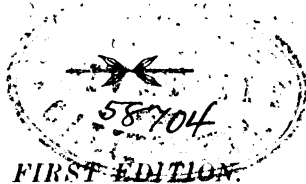
SUBJECTS OF INTEREST

TO

MUNICIPAL OFFICERS.

BY

ERNEST McCULLOUGH.



1894

ERNEST McCULLOUGH,
CIVIL ENGINEER.

Consulting Engineer in construction and improvement of roads, and general municipal improvements. Plans, specifications and estimates for water supply, sewerage and drainage. Economical development of colony and town sites, and suburban residence districts. Topographical surveys. Parks, cemeteries and race tracks laid out.

Engineering enterprises examined and reported upon for investors.

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511 CALIFORNIA ST.,

SAN FRANCISCO, CAL.

PUBLIC WORKS.

A TREATISE

ON

SUBJECTS OF INTEREST

TO

The price of this work is twenty-five cents per copy. Upon receipt of four cents for postage, a copy will be sent free to Mayors, Trustees, Engineers and Street Superintendents of California towns and cities, upon application to the author.

1894

ERNEST McCULLOUGH,
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BY

ERNEST McCULLOUGH, C. E.

Member of the Technical Society of the Pacific Coast,



FIRST EDITION.

1894

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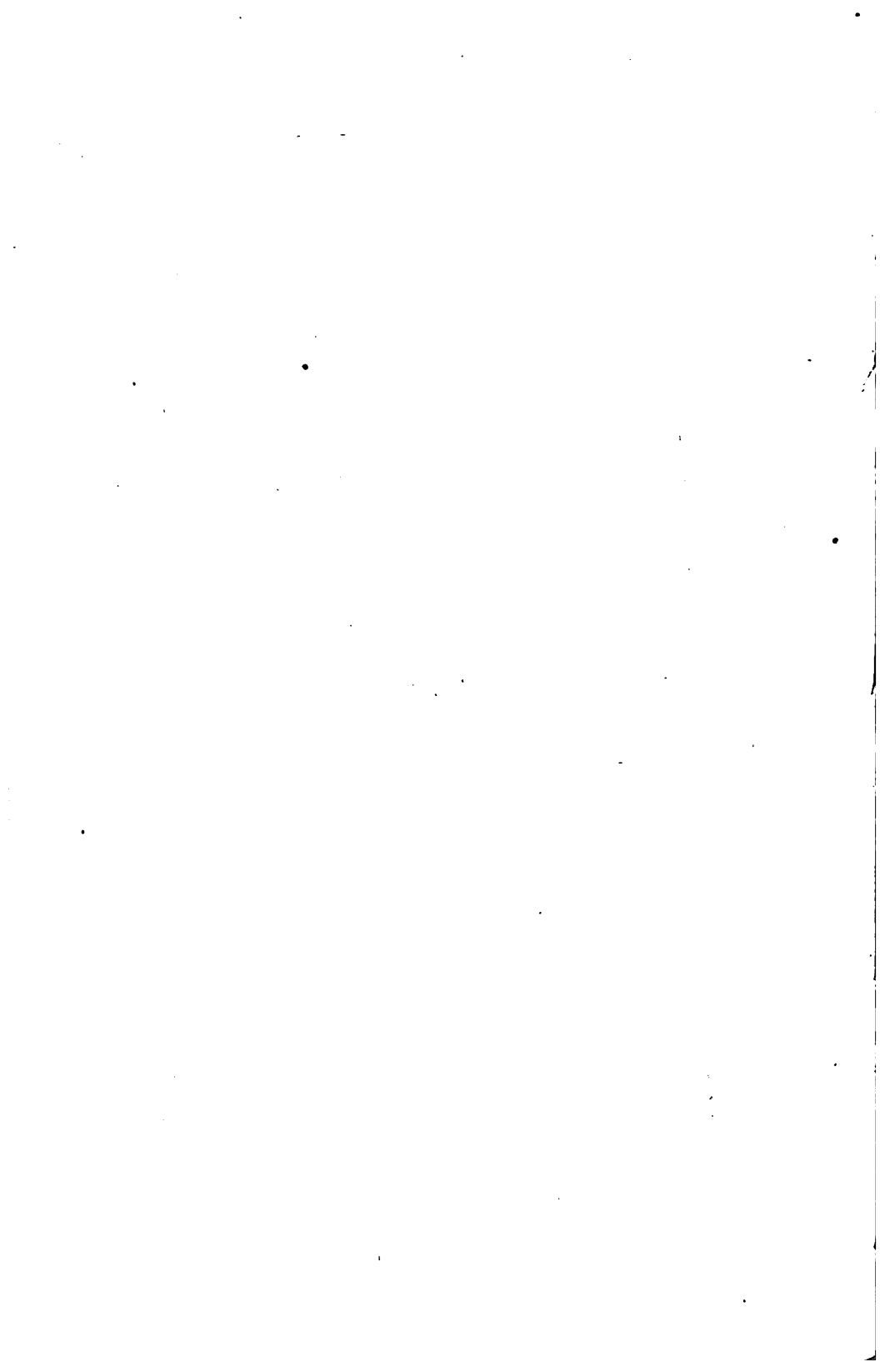
THIS WORK

—IS—

AFFECTIONATELY DEDICATED

—TO—

MY FATHER





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P R E F A C E .

The following articles were written for the Trustees of a California Town, the intention being to discuss from an Engineer's standpoint the various problems with which the Trustees would have to deal.

As the subjects of Municipal Ownership and Bonds are economic propositions it has been considered that there is nothing amiss in an Engineer having his say about them.

In the belief that many Municipal Officers would appreciate the work the articles are now published. It is hoped they will prove useful to some.

THE AUTHOR.

San Francisco, Cal., September, 1894.



CHAPTER I.

STREETS.

Grades.

Among the several reasons why streets are improved the principal one seems to be æsthetic. Everyone admires a handsome street and its improvement increases the value of abutting property.

In establishing grades preliminary to improvement two things are taken into consideration—drainage and traction.

Surface water must be taken care of in regular channels so that private property will suffer no injury during storms. Any slope will cause water to run, but the least grade should not be less than four inches in one hundred feet if possible.

Although water will run down any slope, some are a severe tax on draught animals to ascend, therefore street grades should be limited between the lightest possible for efficient drainage and the steepest a team with loaded wagon can ascend with ease. The steepest grade, if possible, should not exceed five feet rise in one hundred feet.

Grades lighter than four inches in one hundred feet or steeper than five feet in one hundred should be adopted only after most careful study.

Calling the load a horse will pull on a level 100:
Then on a grade of 1 in 100 a horse will pull 90.
" " " " " 2 " " " " " " 81.
" " " " " 4 " " " " " " 52.
" " " " " 5 " " " " " " 40.
" " " " " 10 " " " " " " 25.

Grades steeper than five feet in one hundred should not be tolerated on a business street, and grades over ten feet in one hundred cannot be too strongly condemned.

Sometimes the fear of expense compels the adoption of steeper grades than an Engineer would recommend, but which are satisfactory to owners of abutting property. As they pay the bills, of course it is useless to stir up a quarrel by persistent arguing, therefore they have their way.

If the street is a main traveled one and the steep grade hurts property beyond, the Municipal Officer must remember that "the greatest good to the greatest number" is a good motto.

The improvement of a street is a grievous affair to all concerned, and when such a piece of work is finished those in authority are devoutly thankful.

Until a regular grade is established each man has regarded the street in front of his lot as so much of his own property, and it is hard to persuade him that the Town has any jurisdiction over it. He has sidewalked, drained and paved (?) it to suit himself, and whether above or below the general level is confident that his portion is just where the grade should be. The Trustee who thinks otherwise has an enemy at future elections, and the Engineer is given to understand that he is a meddler and an ignoramus.

Cross Sections.

It is usual to so improve a street that the edge of each sidewalk at the curb line shall be on the official grade, thus giving what is known as a "level cross section."

For drainage the sidewalks slope toward the gutters and the roadway is high in the center. The shaping, or crowning, of the roadway depends upon its width and the material it is paved with. A smooth, impervious pavement does not require much crowning.

Sometimes a street has to be so shaped that one side is lower than the other. Where the difference in elevation is great it is for the reason that a level street from property line to property line is very expensive, but when the difference does not exceed one or two feet it is usually because someone has a fad to indulge, or may be because a compromise had to be arranged to suit the ideas of grade entertained by the owners on each side.

The shaping of a sideling street is a problem not always satisfactorily solved. To crown it in the center gives one-half the roadway too slight a pitch and the other too much, resulting in a bad appearing job; while to give the street a straight slope from gutter to gutter necessitates the passing of surface water over the entire street surface, a practice to be avoided. The center should be kept as dry as possible, but the keeping up of a crown on a sideling street costs more than on a level one. The foregoing objections to sideling streets apply to them when unpaved. Paved with asphaltum, brick or stone blocks the shape can be made to suit the opinions of anyone.

Some towns are laid out on hill sides, and the streets follow the contour of the ground. In such cases it often happens that one side of the street is from five to twenty feet higher than the other. To attempt a level cross section or anything near it, in such cases, is expensive and foolish. It is far better to establish three grades, one for the roadway and one for each sidewalk. Grassed slopes connect the grades, and the street is said to be terraced. The roadway should be flat across and slope to the inner side of the curves. It need only be about twenty feet wide.

These side-hill streets are generally residence streets and should be improved at as slight cost as possible to give them a handsome appearance. All trees which it is possible to preserve should remain,

and it should be endeavored to make the hill side look like a park. The picturesque and beautiful should be maintained.

It is needless to say that if possible all business streets should have a level, or nearly level, cross section.

There are no set rules for establishing grades or improving streets. The streets are to look well, are to serve as drains and as avenues of travel. They are to be improved at the lowest possible cost to attain these ends. All other considerations are matters of detail.

Widths.

The width of a street is from property line to property line. The street consists of a roadway for vehicular traffic and sidewalks for pedestrians. It is common to make each sidewalk one-fifth the width of the street, which for sixty feet will give two twelve-foot sidewalks and a thirty-six foot roadway.

This rule is often departed from, as for instance on streets where retail stores abound sidewalks are wider and the roadway narrower than in the wholesale district where wagons are plentiful and pedestrians move at a rapid pace, for in the one show windows are the attraction and in the other business reigns. In some portions of the residence district where there is little driving except for pleasure, the roadway is narrow to save dust and expense of maintenance and the sidewalk reservation is wide. The actual sidewalks here are oftentimes mere strips of stone a few feet wide with borders of grass between them and the fence and curb.

On a terraced side-hill street the sidewalk is narrow, for the slopes require space, and the roadway as before stated, should be at least twenty feet wide.

Materials.

The materials for paving streets and making sidewalks and curbs should be chosen by a majority

of the property owners affected, the proper officials of course being responsible for quality.

On the score of economy the most common pavement is crushed rock, or macadam, for streets.

A macadamized road well made is very satisfactory. The roadway should first be excavated about a foot below grade and shaped to the street surface. It should then be sprinkled and well rolled. Upon this should be placed layers of stone a few inches thick of varying sizes, the coarser layers below and the finer above and each layer sprinkled and rolled. The last layer should be of material which will pass through a half inch screen.

The stone used should be of good quality and tested by the Town Engineer before it is used. The usual test is one known as the "rattler" test where the stone, broken into regular sized pieces, is put into a box mounted on axles. The box is closed tightly and revolved for a period of time, the motion causing the stones to fall about in the box and against each other. The difference in weight of the whole stones before and after the test represents the loss by attrition and gives an idea of the wearing powers of the stone tested.

Every town should have a "rattler" and a stone crusher with screens. An outfit can be purchased for less than \$1,500. The crusher should be located in some selected quarry and can be kept to furnish repair material for the roads. When a street is to be macadamized it will generally be found cheaper to furnish rock to the contractors at a certain price per cubic yard and let them furnish labor alone than to contract for everything.

Macadam roads must be kept up, and therefore plentiful supplies of repair material should be kept, and a road roller is a necessity. A proper horse roller costs from \$500 to \$1,000, and a steam roller from \$3,000 to \$7,000. The steam roller does more and better work for the same money than a horse roller.

When the town desires to have better paved streets there are many materials to choose from, and dissensions often arise before the choice is made.

A perfect pavement is durable, noiseless, cleanly, healthy and cheap. The perfect pavement has not yet been discovered, but asphaltum and bituminous rock pavements approach it. They are noiseless, cleanly, healthy, very durable, but not as cheap as some others in first cost.

Wooden pavements are not to be commended. It is said they are noiseless, but this is not so true as of asphalt. The first cost is small, but they are not durable or cleanly. The spaces between the blocks become filled with excreta and filth and in a few years they become so rotten as to endanger the health of the community. They do not wear smooth.

Vitrified bricks cost more than wood and make a very satisfactory pavement, but there is difficulty in getting them all of uniform quality, consequently they do not wear smoothly. They are comparatively noiseless, cleanly and fairly durable, but having joints are not perfectly healthy.

Granite blocks are to be commended for only one thing—durability. They are very noisy, and on account of the joints not particularly cleanly, healthy or smooth surfaced. The cost is more than brick and less than asphalt.

Gutters should be wide and built of granite blocks laid lengthwise and cemented in the joints. As horses oftentimes stand for hours by the curbs the gutters should be hard, to stand pawing with iron-shod hoofs, and should be impervious, to keep slops and urine from getting to the soil beneath. Gutters on macadamized streets are generally made of stones four to six inches square, laid by hand and the spaces between filled with crushed stone and sand.

Curbs should be of stone, but oftentimes it is difficult to procure it of suitable quality, so iron or concrete is used instead. The top of the curb is at official grade. Economy oftentimes justifies the use

of wooden curbs, but they should never be used except on macadamized streets. A redwood curb 3" x 15" or 4" x 16" will last a long time. The top of a wooden curb is set two inches below grade, and the sidewalk (of two-inch plank) rests on and is spiked to it. No one would think of putting in a permanent sidewalk and a wooden curb.

The shaping of corners presents considerable variety, but the most handsome corner is where the two curbs join in a curve having a radius equal to the width of the sidewalk. A wooden corner of this sort is best made by driving 4" x 4" posts on a curve four inches inside the curb line and about three feet apart. One inch planks are bent around and spiked to these posts in four layers, making a laminated plank. Plenty of nails will hold them in place, and the finished job looks well.

Sidewalks should be of brick, asphaltum or concrete, preferably the last. They are neat and clean. A wooden sidewalk soon becomes filthy, and when it begins to wear presents anything but a neat appearance. It trips the pedestrian in Summer, and squirts muddy water on him in Winter.

During the present year (1894) contracts for street work in San Francisco have been let at the following prices:

Bituminous rock pavements from 19 to 25 cents per square foot.

Basalt block paving from 16½ to 19 cents per square foot.

Macadamizing streets, including rock gutters, 2 to 4 cents per square foot.

Macadam sidewalks one cent per square foot.

Cobble paving 7½ cents per square foot.

Granite curb per lineal foot from 60 to 95 cents.

Granite crosswalks per lineal foot 70 to 80 cents.

Artificial stone sidewalks per square foot 8 to 13 cents.

Bitumen sidewalks per square foot 7½ cents.

Plank sidewalks from 15 cents to 90 cents per front foot, varying from three to fifteen feet in width.

Redwood curbs 9 and 10 cents per lineal foot.

Basalt blocks for repairs \$32.25 per thousand.

Grading per cubic yard 6 to 70 cents.

The cost of grading, it may be seen, varies between wide limits, and no closer estimate can be given for the cost as so much depends upon the quality of material and depth of excavation.

For cheap work in grading and shaping streets there is nothing which can equal some of the road graders now on the market.

CHAPTER II.

HEALTH AND CLEANLINESS.

It is not enough to have good sanitary laws, but it is necessary to enforce them.

Within a municipality there should not be permitted any cesspools or privy vaults, but if such things do exist they should be perfectly tight that no moisture from them can contaminate the surrounding earth.

The greatest menace to health in any closely settled community is undrained soil, and it should be looked to that anything tending to load the earth with filth and noxious wastes be not allowed. It will be difficult to underdrain a flat lying town and expensive in any case, so here "an ounce of prevention is worth a pound of cure."

Not only cesspools should be prohibited, but piles of garbage, manure, old rags, boxes etc., tend to increase dampness and breed disease. Refuse should be regularly carted away and destroyed. These

things permitted to accumulate retain moisture for a long time and disease germs multiply, the surfaces become dry in warm weather, and as alternate wetting and drying promote decay the surfaces rot and are distributed broadcast in the form of dust by the winds. Filth breeds disease and wind and water spread it. The manure pile and garbage heaps send poison through air and earth in frightful quantities, and only wise laws well enforced can prevent it.

There is a vast difference between sanitary regulations and sumptuary legislation, but it is hard to make the average citizen understand it. As in street improvements any fancied infringement of his rights is warmly resented, the Health Officer has an unpopular job.

Alleys and lanes should be regularly cleaned and all paved streets swept daily. Storekeepers should not be permitted to put the sweepings of stores and sidewalks in the gutters, but have a proper receptacle to receive the refuse which should be often emptied and cleaned.

No laws can prevent people using well water, but in a thickly populated district the dangers of possible contamination should be pointed out and the difference in quality of water obtained from wells in a sparsely settled district and a thickly populated town explained.

Well water is good when no sources of contamination are near, but when the watershed which supplies it has to receive quantities of liquid wastes from habitations it is, to say the least, carelessness to drink it.

Some people imagine that the water percolating through the earth is purified by filtering, but it is a mistake. Suspended impurities are removed by filtering, but whatever is in solution is never removed by such a process. For instance take clay and mix it with water. The water becomes turbid, but after standing awhile becomes clear. Filtering will render it clear sooner, but although the color is gone it does

not argue that the water is pure. Mix salt with the water and filter it. It is colorless but salt, and all the filtering possible would not freshen it. So with liquid wastes from cesspools. In the ground the suspended impurities are removed and the water in the well is clear and beautiful, but the poisons in solution are still there and may cause an epidemic.

Springs are but another form of wells and fit only for use in country districts.

The water supply of a town should be obtained from an undoubtedly healthy source and piped to the consumers.

CHAPTER III.

DRAINAGE AND SEWERAGE.

In planning a sewerage system a distinction is now made between Drainage and Sewerage; the former being a term meaning the disposal of surface waters, and the latter a term providing only for liquid household wastes. Solid wastes are termed garbage.

Drainage.

Surface waters may be discharged into the most convenient water courses. A great portion of the rainfall is absorbed as it falls, but as a town becomes more closely built over and streets are paved, a less quantity goes that way, and proper conduits must be provided for it. Broad, deep gutters will carry a great deal of water, and it is well to provide for surface water by gutters as far as possible, dividing the streams frequently and guarding against their increasing too much in size. When the flow becomes

so great as to threaten the ruin of the street it is time to provide an underground conduit to conduct the water to the wasting place. As this water is comparatively clean it may be discharged wherever it will harm no property.

This is the whole practice in the treatment of surface water. Provide ways for its escape so that no washouts can occur, and keep the streams as small as possible by spreading or dividing the flow.

One of the first things a town needs is a systematic plan for surface drainage, so that whenever a culvert or gutter is built it forms part of a system, and will not need to be torn out afterwards or be enlarged.

Sewerage.

The first act of the officials of a newly incorporated town should be the preparation of plans for a sewerage system.

It should be prepared on the same principle that leads a man to have plans drawn for his house before letting the contract, viz: economy and common sense.

The system can be constructed at once as planned, or be built as needed one block at a time. In a growing town the system is never completed, but is continually growing, and the first plans take into consideration not only present but prospective population.

The point of disposal and sizes and locations of the main sewers must first be decided upon, and lateral sewers can be built as desired. If a system is not early planned it will lead to great confusion and expense.

Sewers are needed, and all who can afford it have private ones. As the population increases, these private drains multiply until there are a great many foul points of discharge in the town, and the people in the low lying districts complain of the foulness of their surroundings. Malignant diseases break out,

and the poorer residents, unable to provide private sewerage, petition for a system. Then the more fortunate and wealthy residents are heard from. Their sewers are built and working well, no disease threatens them, let each man look out for himself, or let them work on the good old Anglo-Saxon plan and stand together to extend the sewers farther. These remarks are frequent and loud and oftentimes prevail for awhile, until an epidemic brings the people to their senses.

But when the system is planned these same private owners, many of them wealthy and presumably intelligent men, do their best to prevent the building of any sewers which will tend to render theirs useless, and oftentimes lawsuits are necessary to compel them to connect with the new system. It is not to be expected that sewers built to serve one or two dwellings can be of much service in a general system. Therefore to design a system a topographical map must be constructed, the sizes, shapes and grades of the sewers determined upon, and if any private sewers are so situated as to be useful it is well, but if not, they should be discarded at once and connections made with the public sewers.

All this means worry and expense, therefore the system should be started before the private sewer owners are strong enough to act against the public health and necessity.

Sizes of Sewers.

There are two systems of sewerage—the *combined*, which provides for storm water and sewage in large sewers, and the *separate*, which provides only for sewerage in small pipes.

The *combined* system is planned by taking into consideration rainfall and drainage area. The sewage is so inconsiderable an item that often it is not calculated. The smallest sewers are twelve inches in diameter, and the ordinary sizes must be large

enough to permit a man to enter them for cleaning. Catch basins are provided at street corners, and manholes at frequent intervals along the streets. The combined system formerly carried the sewage and storm water together, but lately there is a tendency to place pipes to carry the sewage along the sides of the large conduits, and leave the latter for storm water alone.

The combined system is used in large cities, and in some places is the only system to be used, as the storm water, if carried along the street, would be a river. In small towns where the storm waters are not taken far, the separate system is best, and in fact the surface water is needed to wash the streets, for oftentimes they receive no other cleansing.

The *separate* system is planned by taking into account the daily water supply, as the discharge from sinks, baths, closets, etc., is what we term sewage. Pipes in the separate system may be as small as six inches ; the largest seldom exceeds thirty-six inches. Manholes and catch basins are dispensed with, though flush tanks are common to both systems.

Arguments over the two methods have nearly ceased, as it is recognized now that surface water unmixed with sewage is cheaply and readily disposed of, and that the prime motive for providing a sewer system is to dispose of the sewage. It has often happened that an unhealthy town has had sewer plans made which took into account the disposal of surface water also, and proved so expensive that they were never constructed.

The plans were called for because the sewage was a nuisance, and as storm waters did not trouble them there was no necessity for providing for anything but sewage. However, precedent was strong and as past generations used water courses for sewers, they must needs use sewers for water courses.

But this is changed now, and each place has the system best suited for it.

The *separate* system costs about one-third as

much as the *combined*, but this is not always a fair comparison, as localities differ so much in requirements and facilities for disposal, etc.

The sewers should be of such a size that they will run half or three-quarters full. There will then be sufficient current to keep them clear.

A sewer larger than is absolutely necessary to provide for sewage has a tendency to fill up. The stream has not velocity enough to carry all the solids in it, consequently these settle to the bottom and the sewer continually fills until there is a space at the top just large enough for the constant flow. When a large flow comes the sewer is choked. Then the papers talk of overflowed cellars, and merchants want damages.

If the sewer by any means is kept open the large, empty space invites accumulations of sewer gas. Flushing by hose is of doubtful benefit when the sizes of the sewer and hose are compared. Pipes are compared by their sectional area, and for comparison this area is obtained by squaring the diameters. A 15-inch pipe contains $15 \times 15 = 225$ square inches. To flush such a pipe with a $2\frac{1}{2}$ -inch hose is equal to flushing 225 square inches with a $2\frac{1}{2} \times 2\frac{1}{2} = 6\frac{1}{4}$ -inch stream.

The sewer system must be carefully planned, as it is a scientific affair and not a matter of guess work or haphazard calculation.

Materials and Connections.

The materials must be of the very best quality, and the workmanship first-class. An inspector, competent of course and not a politician, should be constantly on hand, and personally watch everything during construction.

The depth of the sewer will depend upon circumstances. It should be low enough to drain the cellars of houses on either side of the street. On side hill streets the sewers of course can only drain the houses

on the upper side, therefore they need not be placed at any great depth below the street surface. In frosty countries they must be deep enough to prevent damage by frost, and where frost does not occur they need only be deep enough to be uninjured by traffic.

The house connections should all be trapped before connecting with the sewer, and no connections should be made with the sewer for at least thirty days after the latter is completed. This gives an opportunity for all settling to occur which will, and removes any danger of cracked joints.

All pipes within houses should be of iron, and no earthenware pipes should be permitted above ground.

Ventilation.

The temperature of sewers seldom falls below 60°(Fahrenheit), and as a consequence the air within has a tendency to seek the higher levels. There is more danger from sewer gas in the higher portions of the town than in the lower, as the natural movement of warm air within is assisted, when the temperature falls, by the colder air, and is forced up.

Trapping the house connections isolates each house, and cuts off an escape of sewer gas there. Ventilation openings should be provided at intervals, and at the end of every sewer a ventilating pipe should be placed. These pipes can start from some house connection between the trap and sewer, and extend up the sides of the house above the roof. Soil pipes should also extend to the roof and be open at the top for ventilation and also to prevent house traps from being siphoned as they discharge.

Grade.

Grade is everything to a sewer. Without a proper grade a sewer is a costly and dangerous thing.

If a street has sufficient grade to carry surface water well, then it may be settled that the grade is

sufficient for a sewer, but the sewer should have inclination enough to produce a velocity of at least three feet per second when half full, for the smallest sewers.

A light grade produces such a sluggish current that solid matters cannot be moved and so remain to clog the pipe, while a steep grade is apt to induce such a velocity that solid matters will be left while the water goes on. Either extreme is bad. As it is not always possible to have a perfect system of grades or a constant flow sufficient to keep the sewers clear, it is necessary for efficiency and economy to have a flush tank located at the end of each line which is liable to suffer.

A flush tank should be able to discharge from 50 to 150 gallons of water in less than one minute into a sewer, and should be adjusted to discharge once or twice a day. A proper system of flushing will require a quantity of water not exceeding two or three per cent. of the total supply of the town. Flush tanks cost from \$50 to \$80 each, in place.

A certain width, not less than ten feet, in the middle of the street should be reserved for sewers, and no water, gas or other conduits permitted there. The sewers depend upon grade, the others do not, and therefore should give way.

Specifications.

When the sewer system is planned proper specifications should be written for the work and every portion constructed should conform to the specifications. The specifications should not only cover the work in the streets, but should apply to house connections. Everybody should procure a permit from the Street Superintendent to connect with the sewer, and the job must be inspected by that official or the Engineer, before being covered. The specifications should prescribe the size and grade of the soil pipe, and the manner of connection, all house connections

to be made by a licensed drain layer, and carelessness or incompetency to be punished by the revoking of the license.

Disposal.

The question of sewage disposal is assuming great importance of late years, and as the country becomes more thickly populated the pollution of streams will be looked after strictly. It is not right that streams from which perhaps some towns derive their water supply, should be used to carry sewage away from towns nearer the source, as epidemics are liable to result, and the people near the mouth of a stream hold their lives and health subject to the will of those above them. Neither is it right for a town to endanger its own health by discharging sewage into lakes or marshes near by.

Sewage is to be gotten rid of as expeditiously as possible, and towns able to discharge into tidal bays or the ocean are to be congratulated, for the filth is carried to sea and there rendered innocuous by dilution.

But interior towns must provide some system of disposal for their waste matters, and future sewerage plans of towns will take into consideration this fact. For this reason the separate system will grow in favor, as it provides a minimum quantity of sewage to be treated, and therefore a saving of expense.

There are four ways of disposing of sewage:

1st. *Mechanical separation.*

This method separates the solids and liquids, leaving a clear effluent to be discharged into the stream or lake. Whether this effluent is harmless is open to question.

2d. *Chemical precipitation.*

The sewage is run into tanks, and a chemical precipitant, such as crude sulphate of alumina, is mixed with it. All solids are deposited, and a clear, odorless effluent is discharged.

In both the preceding methods there is a material left, known as "sludge," which must be gotten rid of. The method used should be one which gives the least trouble and expense. It may be dried in open pits and sold or given to farmers for fertilizing. It may be run on to land and be plowed in, or simply left to dry. It may be dried and burned in kilns.

3d. *Broad irrigation.*

The sewage is run on to land for irrigation. The land is used for raising fruits and vegetables, and can be rented for such purpose by the municipality. Properly planned and executed, this is a cheap and efficient method of disposal.

4th. *Intermittent filtration.*

This is a cheap method and one which meets with more favor than irrigation. The principal objection to broad irrigation comes from people with squeamish ideas, who object to eating anything which may have been irrigated by sewage. For filtration a small piece of land with a porous soil is selected and drained. At intervals the sewage is discharged on the land and allowed to percolate through the soil. It is relieved of all impurities in suspension by filtering, and the slow movement through the filtering bed gives time for thorough purification of all impurities in solution by exposing it to the beneficial influence of oxygenizing agencies.

During the present year (1894) prices for sewer work in San Francisco and other cities in this State have been about as follows:

Manholes and covers complete \$25 to \$50.

Cesspools and culverts with corner complete \$100.

6-inch sewers per lineal foot,					30 to	70 cents.
8	"	"	"	"	40	\$1.00 "
10	"	"	"	"	60	1.50 "
12	"	"	"	"	75	1.50 "
14	"	"	"	"	\$1.00	1.75 "
16	"	"	"	"	1.25	2.00 "
18	"	"	"	"	1.50	2.50 "
20	"	"	"	"	1.75	3.00 "

The cost of sewer laying varies with the depth of sewer and quality of material in excavation, and also with manufacturers' discount. The latter is sometimes sixty per cent from price list.

Brick sewers cost from 75 cents to \$2.00 per foot of diameter in place. Thus, a sewer four feet in diameter might cost from \$3.00 to \$8.00 per lineal foot, depending upon specifications and depth.

CHAPTER IV.

WATER SUPPLY.

That a good water supply is essential to the growth of a town goes without saying, as one of the first questions asked by possible residents or manufacturers is in regard to the water supply.

A man thinking of establishing a business in any town always wants one where good water works can supply him with water for manufacturing, and protection in case of fire. He always inquires about a sewer system, also, to dispose of wastes. If he intends living there he wants good water for drinking and household purposes, and a sewer system to preserve his health.

Sources.

The sources of water supply must be carefully selected, and all danger of pollution should be guarded against.

Artesian wells are well enough when no other source is available, but it is seldom that a well can be obtained of sufficient volume to supply even a small place. A town considering the proposition of

obtaining water from artesian wells must proceed slowly and carefully in order that after the hole is bored and pipes laid, the volume of water to depend upon will justify the expenditure of the money spent to secure it.

It is not safe to figure on less than 30 gallons per day per capita, and the amount, in a manufacturing town, may reach 60 to 80 gallons per day per capita. Estimates based on the total population.

Driven wells are a good source of supply, if there is ample watershed and the sand bed from which the water is obtained is of sufficient body to supply the water as rapidly as wanted. The sealing of the tubes must be well done or the wells will be a constant worry and expense. The wells may open into a large cistern and the water pumped from it, or the pumps may be connected directly with the wells.

This is perhaps one of the best methods for supplying water, but necessitates a pumping system. As few towns, however, are so situated as to be able to have a perfect gravity supply, this can be no drawback. In fact a town with mains supplied by pumps is in a good position as regards fire, for pressure is wanted for fire streams.

Water obtained from running streams must be carefully examined for pollution, and unless perfectly pure must be rejected, or before use be subjected to purifying processes. If obtained from some higher altitude it may be piped to the town and stored in reservoirs for use. These reservoirs must be of sufficient capacity to afford the requisite storage for periods of drought, if necessary, as the supply from streams is variable.

Lake water, unless obtained from the mountains above dairy ranches, is a doubtful source of supply.

When the quantity required is not great, the best system is by pumps with a standpipe or tank with a capacity for about twenty-four hours' supply. The tank furnishes the pressure, except in case of fire when it is better to disconnect it and attach the

pump directly to the supply main. Ordinarily the pump need only be used to keep the tank filled.

With a town of over 3000 inhabitants a direct pumping system is preferable, with several stand pipes in different parts of town, if it is very hilly or broken. The stand pipes will be supplied by the force main, and each will supply its own district.

With a large city a gravity system may be cheaper than a pumping system, but it will require careful planning in any case.

Uses.

Water is needed for drinking, manufacturing purposes, laundries and baths, street sprinkling, sewer flushing, irrigating, fires, etc., and unless it can be used for all these purposes it is not a good commercial water.

It may be all right for cooking and drinking, and unfit for the manufacturer or laundry. It is hard to get a perfect water for everyone, but it can be averaged up pretty well so that the people will be satisfied.

Where the supply is small great economy must be practiced; but when a town is located near the sea, salt water may be used to advantage for certain purposes, and thus the fresh water supply can go farther.

Salt water is excellent for flushing water-closets and for bathing. For flushing sewers it is better than fresh water, on account of its greater specific gravity, and it leaves the air in the sewer very fresh and clear.

For sprinkling streets, in English cities where it has been extensively used, it is highly esteemed. One round of a watering cart seems to do as much good as three rounds with fresh water, and on account of its hygrometric properties it serves to keep the air cool and the ground moist a long time.

For extinguishing fires it is of doubtful benefit,

as the building, if well soaked, will never dry out sufficiently to be a healthy habitation.

Sizes of Pipes.

Whether the town owns the water works, or the water works company owns the town, there should be certain regulations regarding sizes of pipe. It is more economical to buy large pipes and have plenty of hydrants than to buy fire hose.

All street mains should be at least six inches in diameter, as the demand for water increases in a far greater degree than the population. The cost of water-pipe increases rapidly with size, but not in proportion to its value. In a growing town it is economy to lay large pipes at first, and not be obliged to change every little while.

Cast iron pipe is generally in lengths of twelve feet from the mouth of one bell to that of the next when in place.

Cast iron is commonly used, but as compared with wrought iron and steel it may be said that the days of cast iron water pipes are nearing an end. Cast iron pipes represent too much dead-weight compared with their strength, as the best method of obtaining long service before destruction by rust is to make them thick. It is very hard to prevent incrustation in cast iron pipes, and being to a certain extent brittle, they are in great danger of breakage from "water ram."

Wrought iron pipe is preferable, in that it possesses greater strength in proportion to its weight than cast iron. Being "tough" and not "brittle" its elasticity enables it to stand greater shocks. It also retains protective preparations longer, and is not troubled so much with incrustation. It generally comes in longer pieces than cast iron, and therefore has fewer joints, making it easier and cheaper to lay and maintain.

Lock joint, seamless, wrought iron pipe is superior to lap and riveted pipe, in that it is so smooth inside that very little obstruction is met with, and an even flow may be maintained.

Cost.

The cost of a gravity system can only be estimated after proper surveys, etc. The cost per gallon for supply can be calculated by adding together interest on cost of construction, taxes on plant, cost of renewal, salaries, wages, etc., of employes, allowance for accidents, etc., and dividing by number of gallons furnished.

An approximate idea of the cost of a pumping system can be more easily given. The cost of raising one million gallons one hundred feet will range from seven to thirty dollars.

The following estimate is for a town of from 1000 to 3500 inhabitants, in a flat country, and supplied by pumping from wells into a redwood tank on a tower seventy feet high.

Although 6-inch mains should be the smallest used, still, to save as much as possible on first cost, 6-inch mains will be only put in on the main business street, 4-inch mains in the more thickly settled residence district, and 3-inch mains farther out.

SUMMARY.

Land for plant, (say)	-	-	-	-	\$ 500 00
Two 10-inch wells,	-	-	-	-	1000 00
Two duplex steam pumps,	-	-	-	-	900 00
Two boilers, complete,	-	-	-	-	600 00
Erection of pumps and boilers,	-	-	-	-	500 00
Buildings,	-	-	-	-	600 00
One 60,000-gallon redwood tank on 70-foot tower, with foundation,	-	-	-	-	2500 00
1800 feet 6" pipe, 3 feet deep,	-	-	-	-	1350 00
12000 " 4" " " " "	-	-	-	-	6000 00
17000 " 3" " " " "	-	-	-	-	6800 00

Twenty hydrants, assorted sizes,	-	550 00
Twenty-five water gates, assorted sizes,	-	200 00
Special pieces,	- - - - -	200 00
Contingencies,	- - - - -	1300 00
Contractor's profits,	- - - - -	2000 00
Total,	- - - - -	<u>\$25,000 00</u>

This plant should raise 15,000 gallons per hour into the tank, so that four hours' pumping will fill it, and the pumps can be used for direct pumping in case of fire.

The outfit is in duplicate — two pumps and two boilers — so that the town will not be helpless should a fire break out at a time when one pump happens to be disabled.

The cost of operation should be about as follows per year:

Interest and fixed charges,	- -	\$2000 00
Renewals and depreciations,	- - -	1000 00
Extensions,	- - - -	1000 00
Engineer and fireman,	- - - -	1150 00
Fuel, etc.,	- - - -	500 00
Total,	- - - - -	<u>\$5650 00</u>

The pumping capacity being large the above system will serve for some time.

The town of Hanford, Cal., in August, 1893, was supplied with a water works system for \$20,000, bonds being voted for payment.

The population is about 3000 or 3500. The town site is comparatively level, and the pipes are supplied by direct pumping. The pump cost \$1400, and the pipe is eight inches, six inches, five inches, and four inches in diameter, very best quality of lock joint wrought iron pipe, treated inside with a preparation of lead, tin and nickel to prevent corrosion. The lengths are about the same as given in the foregoing example. A fire alarm system and 2000 feet of fire hose was included, and 32 double-nozzle hydrants. No tower or tank.

Probably as complete data can be obtained from other small towns. The estimate given and the example shown will aid in determining the probable cost of a water supply system for a small town.

Ownership.

There should be no franchises given for a water works system in any town or city, but each should possess their own. The interests of the people will be better served and fire protection assured.

To establish a proper sewer system and enforce sanitary regulations which call for the consumption of much water, without also owning the water works, is equivalent to stealing from the people the profits earned by the water company. If the town owns the water works, the exact cost of running them, as figured above, can be ascertained each year, and the water rates fixed on that basis.

It is as much the duty of the municipality to provide pure water as it is to provide sewers, but when considering it from an economical standpoint it is assumed that politics will have nothing to do in the administration. Water can be furnished at cost or made to bring a revenue. It can also be a source of expense.

CHAPTER V.

SURVEYS.

Many of our towns have been settled so long that all the original survey stakes have disappeared, and a "happy go lucky" way of establishing fences and erecting buildings has crept in, with the result that

it is almost impossible to re-establish the original lines with any certainty.

The longer such a state of affairs continues, the worse the confusion, and the prospects of costly law-suits are promising at some future time when land has increased in value.

Re-Surveys.

When the need of some proper definition of boundaries is realized, and a re-survey is made, it should be made by a competent Engineer, and should show the following objects when platted:

- 1st. All fences and buildings on the street line.
- 2d. All corners of lots and buildings supposed to mark corners.
- 3d. All original corners, stakes and monuments which may be in at the time.

The above should be platted on a scale of 50 feet to an inch.

All original deeds and descriptions on record should be platted on the map, and corners and boundaries adjusted with great care. It is a risky thing to disturb long established possessions, and only the most careful and conscientious work will do. It is a combination of legal and engineering skill to do such a job in a way to satisfy the *majority* of the residents, and the longer it is put off the more troublesome it will be. The name of Geodetical Jurisprudence has been conferred upon this part of an Engineer's duties, and it is a fit one.

The map should be platted on cloth-mounted paper, on sheets of about 24 x 36 inches, and when all the lines have been adjusted and the work officially accepted these sheets should be well bound and filed with the Clerk as a part of the Public Records.

Permanent monuments should be established in various parts of town, and well located so that no more trouble can occur.

Working Maps.

The maps of the boundary surveys are to be kept in case of future trouble, and there is an amount of detail which will be of no use on an official map, therefore the town should have an official map after all the lines have been adjusted.

This map should be on sheets of about 24 x 36 inches, and should show:

1st. All street and lot lines as re-established, with courses and distances.

2d. All monuments established to preserve the lines, their kind, number and location.

3d. All sewers, water and gas pipes, their length, sizes and material, and all drains, culverts, etc.

4th. All water courses and streams within the town limits, their size, direction, and points of discharge.

5th. Contours on all the streets, showing the elevation above some base, or plane of reference, which has been adopted as city base.

The data for these working maps can all be collected when the boundary survey is made, at a slight increase in cost. A complete survey, as above, will give the town data from which to establish grades, put in sewers, and in fact make all improvements. The field work of surveying is expensive, and can only be prosecuted in favorable weather. Office work is cheaper, and can be done at all times. It is economical to do all the field work at one time, and have data at hand so that when the cost of any street or sewer work is wanted, the Engineer can, by working awhile in his office, give his estimates. Sometimes this information is wanted quickly, and bad weather may so prolong operations that the cost of Engineering services on a job will be out of all proportion to the cost of the work itself.

The scale of this map should be one hundred feet to an inch.

Levels.

A plane of reference should be selected from which to figure all official elevations and grades. The mean of lower low tides is a good plane of reference, if any government bench marks are near enough to ascertain it; or low water mark in the stream into which the sewer outlet discharges may be taken. The plane of reference can be termed zero, and elevations described as being so many feet above or below it.

Frequent bench marks throughout the town, referring to city base, should be established so that long lines of levels will be avoided in doing any work. One or more of these benches should be established by ordinance, the rest can be fixed by the Town Engineer for his own convenience.

Street Extensions.

All subdivisions of land within the town limits should be subject to approval of the Council and Engineer before the streets are accepted. The Council can prescribe the width of the streets and the maximum grade. The plats should show proper connection with adjacent city monuments, and have monuments at each corner. The elevation of all corners referred to city base should be shown in red ink. At the time the official map is accepted an ordinance should be passed, dealing with future subdivisions, additions, grades, etc.

General Maps.

For the purposes of street assessments, tax collections, water rates, etc., it is a good plan to have on hand lithographed maps of the town on a scale of about four hundred feet to an inch. These maps will show only street and property lines without field notes or elevations. They should be on sheets about one foot square. Several pasted together will make one

full map. Citizens wanting maps can buy them from the Clerk, and sometimes enough may be sold to pay for the printing. In any case they will be extremely valuable and will save too much handling, by outsiders, of the more full and complete official maps.

CHAPTER VI.

CONTRACTS AND WORK.

Specifications.

For all work there should be complete specifications, carefully drawn, and nothing should be done without such papers. The smallest piece of work will be done in a more satisfactory manner when both parties have plain directions, than when such directions are wanting.

Complete specifications are plain descriptions, with drawings if necessary, in detail of the work to be done, and should form a part of the contract, which recites the circumstances under which it is taken, and the rewards and punishments for its faithful or non-faithful execution. The specifications should be drawn by the Engineer, and the contract drawn by the Attorney.

Contracts.

No contracts should be let for any work until an estimate of cost has been made and submitted with the specifications and plans.

Estimates of cost are generally given to assist in determining whether or not the work should be prosecuted, and when it is decided to go ahead plans

and specifications are called for. When these are complete a careful estimate of the cost should be made and left in a sealed envelope with the Clerk; all bids to be submitted in sealed envelopes and not opened until the proper time. The exact estimate of cost being known only to the Engineer, it being assumed he is honest, goes far to prevent pooling.

When the time for opening the bids arrives, the Engineer's estimate is first opened and the lowest responsible bidder gets the contract, provided, in the Engineer's judgment, he can do it at the figures given. If the bids are all far above the estimated cost, it remains for the Council to decide whether to let a contract or do it by day's work. If the Engineer is competent and they have confidence in him, this is perhaps a good way to settle it. In some States, however, the law reads that all work estimated to cost more than a specified sum must be let by contract. By dividing the work into sufficiently small sections the law is sometimes evaded, but strict honesty does not justify such a proceeding, and there is no economy in it.

When the contract price for a piece of work exceeds the estimate, then it is far better to do a less amount of work than to try to save money by altering the plans and specifications, as is often done. They were drawn to secure first-class work, and first-class work is always the cheapest.

Work.

It is not economical for the municipality to furnish paving or sewer material and contract simply for labor, as the inspectors are apt to be lenient in passing imperfect material in order to save loss. The only way is to have the contractor furnish everything, and have it rigidly inspected before being put in place.

An exception can be made in favor of macadam, as the town should own, or lease, a quarry and fur-

nish macadam at cost from its own crusher and screens.

There are many men with teams, who should be encouraged to bid on all street work, and if the town owns road rollers and sprinklers they can be rented to these small contractors. If obliged to furnish such tools it would be impossible for them to compete with large firms.

Therefore, if a town invests in rock crushers, road rollers and sprinklers the roads can be kept in repair cheaply, and they will be the means of keeping a great deal of money at home.

It is often stated in advertisements for bids, that a certain number of hours will constitute a day's labor. In fact, some State laws require it, and no one can take exceptions to such a law, which is drawn in the interests of humanity.

When contractors are notified that they must pay certain wages and employ local workmen, neither reason nor justice can endorse that action. It is the demagogue and not the philanthropist or humanitarian who inserts such a provision. Also, when it is stated that a certain percentage on the cost in favor of local contractors will be given, the results are pernicious.

The Officers are elected to do the best for the people and not to encourage any industries. With wages and residence of workmen they have nothing to do. The work must be done as reasonably as possible, and the people must get the most for their money. To encourage home labor by such restrictions on the contractors, always results in costly work and aids in pools. The workmen, so far from feeling grateful, use the Council as a lever to force open the treasury doors, and the contractors find labor scarce and very independent when protected by those in authority.

It is well to encourage home industry, but such help should not go farther than the renting of tools to local contractors as before stated. The rent to be paid for their use can be ascertained by the bidders

before the date for submitting bids, and will be an item of cost to them.

But when it is stated that "the lowest local bidder will get the contract, provided his bid does not exceed by — per cent the lowest outsider's bid," the taxpayer has a right to rebel. Such provisions are not honest, and tend to the formation of combines to run up the price of work.

For economical work there must be good specifications, honest bidding and letting of contracts, with *competent* supervision, and severe penalties for non-performance and shirking.

Dry nursing of local labor and employment of day's labor are to be avoided.

CHAPTER VII.

PLANS.

When plans for sewerage or water supply are desired there are two methods only which can be considered, one of which must be adopted.

The first method, which is undoubtedly the best, is to select a competent Engineer and have him prepare the plans. Pay him a fair price for his work, and give him every facility in its prosecution. This is a proceeding in accordance with the old saying, "Every man to his trade."

The plans when completed must of course be presented to the Council and accepted or rejected, but not passed upon as by experts. The Engineer is the man whose supposedly superior knowledge of the subject the board are to rely upon, and for this reason he was employed. Any criticism of technical or scientific features of his work are out of place if

his selection was on account of ability. Questions of expediency alone govern the selection or rejection of his plans. They may be too high-priced, or perhaps do not suit certain local conditions to the satisfaction of some. The changes suggested he can consider, and if practicable the plans can be modified. If not practicable he should then be prepared to defend his ideas. By using care in the selection of an Engineer, and dealing with him as with a business man, it will be found that good service and economy may be secured.

The great objection to the above method is that in practical politics there is a mysterious factor known as "pull." This pull often operates disastrously to a town's best interests, when it is proposed to employ competent men for any purpose. In the appointment of the "expert," one is sometimes called whose assumption of the claim to be considered such is unwarranted. He is employed out of gratitude for past favors received, or prospective favors to be granted, or out of friendship to some one of authority in local affairs. It happens that once in awhile, when intending to do their full duty, the town officials unintentionally fail through ignorance of what really constitutes a competent man for the work in hand.

The second method is to advertise for plans, and offer a bonus for the best one or two.

This method if properly followed should result well. In the first place the time in which to prepare the plans should be ample, being from one to six months according to the importance of the town. One reason for giving plenty of time is to enable competitors to study the matter carefully and not compel them to rush it through. Another reason is that only one or two win, therefore a number must work for nothing. By giving plenty of time these men can give their spare time to the work on which they take chances of payment and lose nothing else. First-class men being generally busy time counts, and if

compelled to drop other work for the bare chance of winning a bonus they decline to enter into competition, and their fellows who happen to be doing little reap the benefit. By giving time enough to prepare plans the town stands a good show of securing them from better men.

In the second place the data furnished should be full. A blue print of the town should be furnished, with all the official elevations marked thereon. Where grades have not been established, contours of two or three feet interval should be drawn. All existing sewers (if a sewer system is desired) or pipes (if a water supply system) should be shown, with their sizes, material, condition and elevations, and all other data which will be useful. A printed description of the place and all information regarding it which will help should be prepared.

Thirdly, the advertisement should state the time plans will be judged, the amount of work desired, the amount of prizes and their number, where the plans should be sent, whether they will be judged by the Council or by competent Engineers, and provide that all competitors should mark some sign or symbol on their plans and reports, and deposit a sealed envelope containing their name and address with the Clerk of the Board, the sign they use being on the outside of the envelope. This will aid in a fair selection, for if no jobbery is indulged in all plans will be judged solely on their merits, and none of the authors of the plans will be known until the premiums are awarded, when the envelopes are opened. The unsuccessful competitors, if they so desire, may have their plans returned without mention made of the fact, for a man suffers some loss of reputation if unsuccessful in such a competition.

There are several reasons why the selection of the best plans should be left to competent Engineers, the most important one being that few Engineers of standing and ability will enter plans otherwise, thus the town is a loser. Sometimes Engineers of un-

doubted ability will present plans for the judgment of the Council, but it is generally in cases where there is a surety of honesty and fair play, or through fear that some mediocre plans may be adopted and the profession injured. There are other reasons of course, some of them hardly creditable.

The plans should be judged by Engineers because their education and training are for the purpose of fitting them for such work, and there is more in it than the ordinary man has any idea of. A town official, if not trained in such special work, is apt to judge plans entirely by their first cost, or as affecting a certain locality.

Take a sewer system, for example. It is a highly scientific and complicated affair, and there are innumerable details about it which can only be properly judged by one who is a specialist in such matters. The business man is not supposed to know why a certain sized pipe which will do in one place is too small for another; he does not know why, in several blocks of sewer, each increase in size calls for a corresponding decrease in inclination; he does not know why the pipe entering a manhole should discharge above the bottom of the discharging pipe, if of a different diameter, he cannot keep up with the times and understand the utility of certain devices and the worthlessness of others.

Plans may be called for, and the Council pass judgment. A number come in, and the authors with them. Each presents his own side of the case and the officials get puzzled. Finally a selection is made on the ground of cost and perhaps when too late it is found to be the most costly of the lot. Some man presents a plan costing a certain amount, which he claims will drain every portion of the city, but his estimates cover main sewers alone. Another with perhaps a far cheaper system has figured the cost of every foot and loses on account of it.

With Engineers judging the plans this could not occur as they would detect at once anything of

the kind and render a report accordingly. Bad practice can be detected and mistakes seen. The plan which is really the best will be selected and the people get good value for their money.

In some places there seems to be a dislike to consult Engineers on such matters and notably in the Western States. To examine sewerage plans a committee of plumbers, architects and physicians will be appointed, with perhaps a contractor or two, while to examine plans for water supply, stationary engineers, machinists and contractors are favored. The much vaunted "sense" of the business man is relied upon, yet this same business man calls in physicians when ill, lawyers when sued, and carpenters to build his house. To employ the physician or lawyer to build his house and consult the carpenter when ill would be extremely bad form and not economical. The inferences are obvious.

CHAPTER VIII.

MUNICIPAL OWNERSHIP.

The items of cost in any enterprise may be generally stated as follows:

1. Interest on investment.
2. Taxes on plant.
3. Extensions.
4. Renewals and maintenance.
5. Labor, supplies, etc.
6. Administration.
7. Profits.

The first and last items are sometimes so closely connected that they are synonymous, but the investment then is not gilt-edged unless the stock is watered

It is the hope of profit which leads men to organize companies to supply public needs, and to some economists the idea of saving the profits to the users is very alluring. Therefore we hear municipal ownership of all kinds of schemes advocated.

It is urged that under public control the only items of cost are as follows:

1. Administration.
2. Labor, supplies, etc.
3. Renewals and maintenance.
4. Extensions.

Profits, taxes and interest are saved, therefore the consumer gets his goods at bare cost or perhaps a small profit may be made to help defray the cost of other non-productive properties.

It is a well-established fact that the residents of a municipality must take care of their own wastes as there is no profit in a sewer system to tempt private enterprise. The only return from a perfect sewer system comes from the safety to health guaranteed by its presence and therefore a possible increase in prosperity as population will be attracted. The effluent from the disposal works may bring in some return but never enough to be profit on the whole system. Therefore, if the people want good sewers they must own them.

Sometimes there is profit in garbage and companies are organized to collect it and sell what can be saved. There is always much left for the municipality to take care of even after these private scavengers get through so the profits are not large enough to tempt the public.

Water is an absolute necessity and private companies often make large profits. For health and fire protection it is so necessary an article that it is as much a thing for public ownership as a sewer system. But the hope of saving in cost should not wholly influence the economist as the fact that the water supply is under complete control is the principal factor in settling this question. Sometimes municipal own-

ership is so expensive a luxury that although taxes, interest and profits are saved, the people are extremely liable to pay more for their water than the private company charges.

The reasons are simple. In a private company an employee's value is rated by his earning capacity. His efficiency for the work in hand is somewhere nearly proportioned to the work expected of him. In a municipality it too often happens that a man's fitness for the position he holds is apt to be gauged by his usefulness at election time. Patronage more than efficiency governs his appointment.

Therefore it is that public enterprises are so seldom economically managed. While the elected officers may be perfectly honest in their intentions, and do their own work to the best of their ability, their appointees have no such feelings but each is intent on feathering his nest before next election day.

Sometimes our City Halls have a gas or electric light plant, but it has seldom proved economical. The light being, as it were, free is used wastefully, and the impossibility of keeping the department out of politics is another drawback.

Advocates of wholesale municipal ownership are no doubt honest in their intentions and beliefs, but deficient in perception of economic facts. Anything tending to an increase in salaried positions tends to increased expenditures and increased danger of political control or "bossism." With an enlargement in scope of the Civil Service idea, it is possible our municipalities may safely and economically engage in various lines of business, but not otherwise.

If economy and cheap service are desired, wise laws well enforced will serve everything. Men live in communities for the sake of advantages offered by such association, and not to become members of joint stock companies; therefore it is a question if it is not an encroachment upon individual rights for a city to engage in business for profit. The members of the Council will have their hands full if the sewers, schools,

parks, streets, police, fire departments, and the one thousand and one et ceteras are looked after properly.

It is always economical for the municipality to own all buildings it needs, as interest on their value will be less than rent. But to own buildings to rent is bad because of the employees required. It is wisest if a municipality owns buildings it does not require itself, to lease them as a whole.

Street sprinkling is sometimes done by the municipality and sometimes by individuals. The practice is not at all uniform, but it is generally considered that the work should be done by and paid for by the municipality. During the season the sprinkler should make three rounds daily and one round early on Sunday morning. The cost should not exceed one hundred dollars per month for each mile. It is economical for the municipality to own the sprinklers and rent them to men with teams to do the work by contract, the water being furnished also by the town at a certain price per hundred gallons. The reasons are obvious.

The subject of street sweeping is one which becomes important as the mileage of paved streets increases, and every large city has much valuable data on the subject.

In St. Paul it cost last year about \$8.67 per mile to sweep the streets. The work is principally done by machines, and the refuse is shoveled into carts and carried to dumping places. The men work all night, and around the business centers the streets are swept each night. The principal paved streets outside the business center are swept twice a week, and an endeavor is made to clean the whole city each Saturday night for the comfort of Sunday drivers. The teamsters furnish their own teams and receive \$3.25 per day; shovelers get \$1.60 per day, and foremen \$2.10.

In San Francisco machine sweeping has been the rule, and the contract price has been since July, 1892, \$16.40 per mile. Some streets have been swept

daily, except Sundays, while others are seldom touched.

The Merchants' Association became dissatisfied with the manner in which the work was done, and have this Summer conducted extensive experiments in the business portion of the city. They have given employment to a great number of men, and the work has thus been a real charity. As a result the streets now look well and the merchants are moving to secure continuous service of like nature. With labor at \$1.25 per day, it is claimed that the cost of sweeping a street and keeping it clean all day long is \$30.00 per mile. After the street is swept one man can take care of three ordinary blocks. To sweep a street once each day by hand, the cost is \$15.00 per mile. With machine and hand labor combined, one daily round will cost \$10.00 per mile. This city has few level streets, and therefore the above figures may seem high. Long stretches on slight grades can be more cheaply done than short, hilly sections, and a continuance of the present experiments in a larger territory will be looked to with interest.

As a suggestion toward the solution of the "unemployed workingman" question, it might be a good plan for the municipality to own all street sweeping tools and machinery to let to small contractors. Have the districts small, and contracts let for short periods. The unemployed could contract for the work and use the public property, paying a small rental. It is possible that in this manner the work could be done at extremely low rates, and the genuine workman, who disdains to beg, be helped. The hungry man never "pools," but if such a thing does happen, and a disposition is manifested to run up prices, men can be hired by the day. The sweeping being done at night and after business hours, gives the men some opportunity to look for work and do odd jobs. When business is good and there are few unemployed, the work will be comparatively high, but it can then be afforded, and machine sweeping will be the rule. When

times are hard contracts can be let more cheaply, as there will be keener competition and hand sweeping will be the rule. As it is then a time when economy is the order of the day the municipality will be the gainer.

In regard to franchises or privileges for conducting certain enterprises, great care should be exercised. There is evident each year a stronger recognition of the fact that franchises are oftentimes extremely valuable, and the public should get a larger return than heretofore for privileges granted. When an application is received for a franchise a competent man should be selected to make a careful examination and report upon the project to ascertain the possible value. The application and report should be published, together with the terms upon which the franchise will be granted, and upon a certain day the highest bidder will receive it, provided some stated amount at least is bid. Provision should be made so that if the original applicant is overbid, he should have the right to offer ten per cent more and get the franchise.

The terms of the franchise should be about as follows:

The streets are public property, and the right to use them for certain purposes does not transfer ownership; therefore changes of grade, etc., are still under control of the Public Officers, and an understanding should be had that the municipality shall pay no part of the expense of raising or lowering pipes or conduits, or changing car tracks or any other work the company may have to do on account of changes desired by the people.

The limits within which the company shall operate should be defined plainly, and severe penalties provided in event of the territory not being occupied within a certain time.

The cost of public and private service, and the quality of service prescribed.

As compensation for the privilege (not exclusive) of using the streets, the company should pay from five to ten per cent of its gross receipts into the treasury, and provision made that when the company makes a profit of over six or seven per cent on its actual capital invested, the municipal treasury shall receive twenty per cent of such increased profits, in addition to the percentage on gross receipts.

The authorities should retain the right of inspection of the company's books and works at all times.

The company should deposit a guarantee fund or bond, equal to its construction fund, with the Treasurer, until construction is finished.

A renewal fund equal to twenty per cent of the invested capital should be invested in bonds of the municipality and kept on deposit with the municipal authorities.

Specifications for all work must be approved by the proper officers.

Street car companies should lay only standard gauge tracks, so that vehicles may travel easily and the space between tracks should be well paved. Tracks in the middle of a street concentrate travel upon the sides, and the cost of street maintenance is thereby increased. On macadamized streets the cost is more than doubled, therefore the company's proportion of cost in street maintenance and improvements should be decided.

On street car lines propelled by other than animal power the maximum speed should be prescribed.

Electric roads should be required to stand the expense of all damage caused to public, private or corporate property by electrolysis. A clause of this kind is better than reams of specifications for construction.

Franchises for power and light should be very explicit as regards using the streets and safety to the public.

If wires are permitted above ground there should be only one line of poles on the streets; owned by the

municipality and rented to the various companies using them.

Ordinances regarding wires should be strict. No dead wires should be permitted to remain, as sometimes a loose end of a dead wire may circuit with a poorly insulated electric light wire and the results be disastrous. Electric light wires should be thoroughly insulated and all wire routes as parallel as possible to diminish the liability of crossing.

Finally, a franchise should be granted for a certain limited period with a provision that in certain contingencies and after a certain date the municipality can acquire the whole plant and appurtenances by purchase upon a fair basis of valuation to be provided for in the contract.

When the plant becomes public property it should be leased, under complete municipal control to private companies. The lease can be bid for and the company offering the most satisfactory terms can have it. These leases should be for long periods.

In connection herewith it may be stated that there is now a law in California requiring all counties, counties and cities, cities and towns to sell franchises to the highest bidder and making it unlawful to grant them otherwise.

CHAPTER IX.

BONDS.

The time is sure to come in the history of every municipality, when bonds will be issued for some work. The issue may prove a blessing or a curse and should be carefully considered before undertaken.

It is unwise to issue bonds for "improvements";

the nature and amount of said improvements to be settled after the issue. The issue should be for a specific purpose. If for any necessary work careful surveys and estimates of cost should be made and everything as carefully done as though contracts were to be at once let. The reports and estimates should be published and the people given a chance to judge of the matter. When the bond election occurs there can be little doubt of the result.

Unless the municipality issuing the bonds has a sufficient financial rating, that is assessed valuation; and the debt is kept well under, say five per cent of that assessed valuation, it is almost impossible to negotiate bonds, except to speculators at a large discount.

The insufficiency of the security does not operate against the sale of bonds so much as ill-advised action in their issue. Such operations are often undertaken hastily and without due care. Records are scanty and a lack of detail shown which affects seriously their security and hampers their sale. Bonds are sold at a premium, at par or below par. To secure their sale at par or premium, all action taken in regard to the issue should be deliberate and the records full. It is better that the records be prolix than injured by want of particulars.

In all large cities attorneys of recognized reputation have made a specialty in the issuance of municipal bonds and follow that line of practice to the exclusion of others, and it is very often cheaper for the municipality to employ them than it is to employ attorneys at home who, from the fact that local issues of bonds are few and far between, have not the same means for keeping posted in that particular line enjoyed by those situated in commercial centers. The plans and estimates for the work and the proceedings of the Council should be constantly under the guidance of the best legal talent, and when the issue is an accomplished fact it is not likely the bonds will go

begging or have to be sold below par on account of some small mistake.

A mistake in a bond issue has three effects: It results in increased expense; it causes all securities of the place to be looked at suspiciously, and it holds the Officers up to ridicule. A Public Officer can stand mud-slinging, abuse or wrongful criticism, but once made a target for ridicule much of his influence is gone.

The issuance of bonds for long terms enables them the more readily to command a premium, but is conducive to extravagance. The longer the day of reckoning is put off the more apt people are to borrow. It is well to remember that although ways of obtaining money are each day made easier, the time-honored method of going down in the pocket to repay the loan has never been superseded. The old adage about death and the tax collector serves all modern purposes and is as true now as it ever was.

In addition to a long term of payment being conducive to extravagance the interest account is a tremendous item. Not only the interest on the bonds is paid but the interest on an idle redemption fund is a serious loss.

Owing to the accumulation of loanable funds the rate of interest is lowering year by year. It seems advisable, therefore, that bonds be issued for no longer terms than ten years, when they can be refunded. Capitalists do not favor short terms, and dilate upon the expense attendant upon a refunding issue. Short term bonds seldom command a premium, but that is a sort of screw used to make borrowing common and easy.

Capitalists also favor bonds of large denominations, but experience has shown that bonds of \$25 or \$50 denominations are generally sold in the neighborhood of the issue if not over say \$100,000, and thus the interest is kept near home.

The theory of a bond issue is this: It is seen that the expenditure of a certain sum of money will

produce certain beneficial results. To obtain this money the party having it is promised a share in the profits for a certain length of time for the use of his money. He is not a thief or a robber but simply a party in a commercial transaction. If he abuses his opportunities and can manage to loan his money for a longer term than is necessary, he displays business shrewdness more than is possessed by his partners for the time being. The interest on the money is his share of the profits, and if a plan can be devised to keep the interest close at home with the rest of the money, or in other words secure a resident partner, the community is a gainer.

In a settled community of slow growth there is no doubt that direct taxation is the best method of paying for improvements. People's needs increase faster, however, than their means, and in a rapidly growing place it is not likely that anything will be found to supplant bonds.

The plan of redemption should be such that the people will always feel it slightly and not with the idea that their descendants will pay. This checks extravagance and encourages thrift. As the years go on it will be felt less owing to increased population and value of property and decreased assessment on each hundred dollars' valuation.

As to sale of bonds. Several brokers inviting bids will hurt their sale. The City Treasurer alone should attend to the matter and hawking them over the country should not be permitted. A trip to the money market with a pocket full of securities to negotiate for expenses while endeavoring to sell the issue is a reprehensible practice, and yet it has been done.

It is so common to issue bonds hastily and without proper consideration that it is hoped the foregoing remarks will be of some value in preventing mistakes.

There are many firms which deal exclusively in such securities, and from them much valuable advice

may frequently be secured. It is to be remembered, however, that such advice is given in the interest principally of men who demand a safe investment.

Any large, established Bond House in the country will cheerfully answer inquiries as to what they consider the best way of making any particular issue of bonds, and it would be well for municipalities, before determining in what denominations and for what time to issue, to ascertain what the market is by writing to some house or houses dealing in bonds. They need not necessarily follow the advice they get, but generally they can profit some by obtaining suggestions of a house which follows the market very closely and which knows the style of bond which is best adapted for the then existing market.

It is well to obtain all the information possible from reliable sources before taking any move. Such information should be regarded as an aid to judgment, and not allowed to pervert it.

With all the information obtainable in their hands the committee having the matter in charge are prepared to co-operate with the legal adviser. Under his direction the issue can be arranged and the people be well satisfied with the result.

Getting away from bonds and to the subject of easy payment of indebtedness, or ingenious financiering, the following story from the *Scientific American* of December 4, 1886, might not be out of place. The people of Guernsey needed a meat market but had no money to build it. After due consideration it was decided to issue £4,000 secured on "the whole of the property on the island, said to be worth four millions." A provision was introduced making the notes worthless outside of Guernsey, and so they were never exported. They were in denominations of one pound and numbered from 1 to 4,000. They bore no interest and circulated as money. With them the contractor was paid and he paid for labor and material with them. Tradesmen took them for goods, landlords for rent and the authorities for taxes.

When the market was completed it was leased for ten years at an annual rental of £400. Each year ten per cent of the notes were redeemed, beginning with number one, and at the end of ten years the notes had disappeared from circulation. The people had their market without any inhabitant having paid one farthing in taxes, and ever since that time it has been a source of large revenue to the State.



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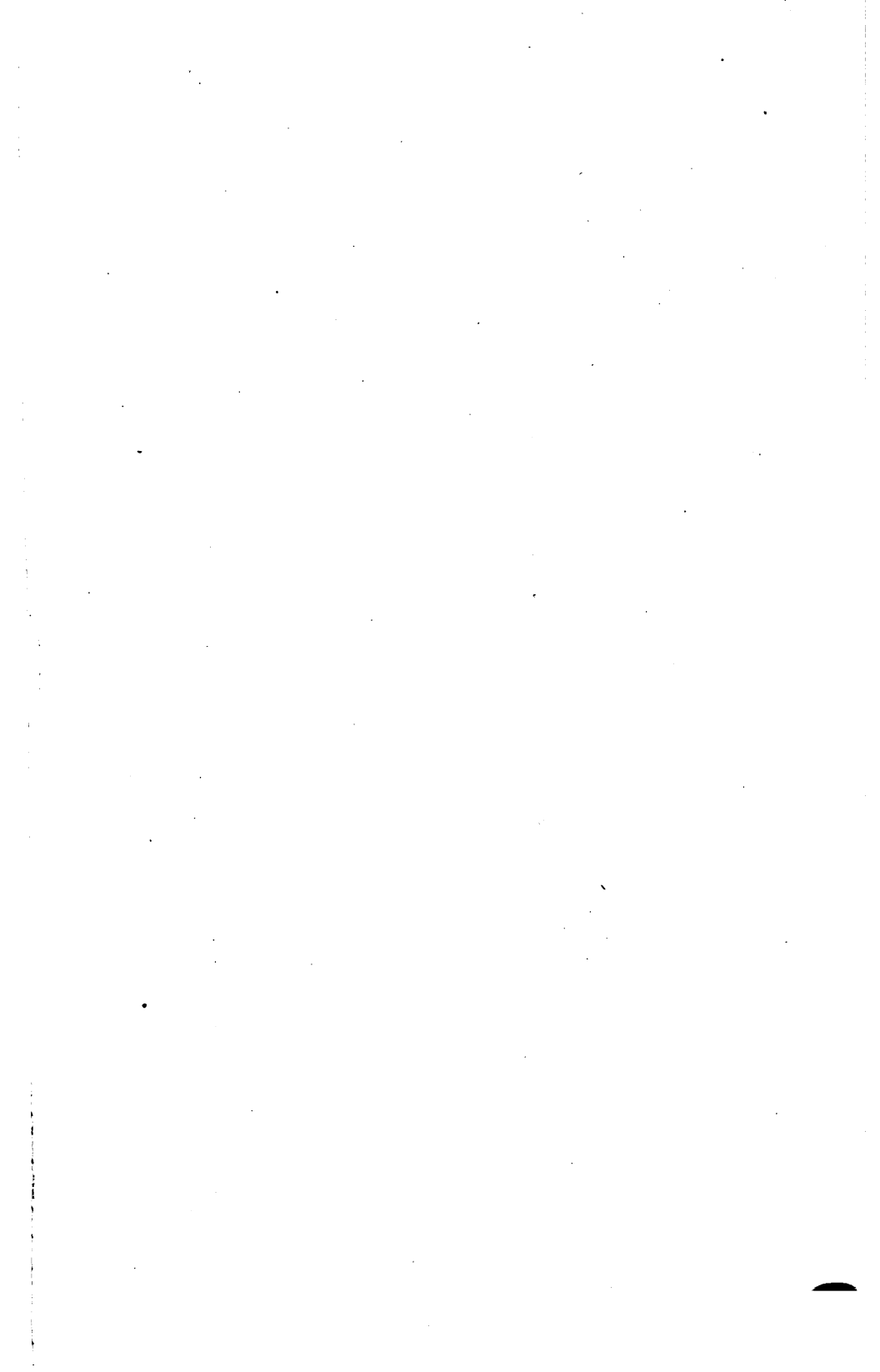


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